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POST-WAR PLANS*

MAY I offer you a warm welcome and my sincere thanks for the trouble you have taken in coming to Simla. I am afraid you have been put to considerable inconvenience and discomfort, but the work on which you are about to enter is of national importance—the shaping of the future of our primary industry—and with this thought let us begin our work.

I am not going to weary you with a long speech. You have before you valuable notes prepared by a committee of I.C.A.R., Sir Herbert Howard, Dr. Baini Prashed and Dr. Burns, which present a picture of our present and future problems. Discussions in this Committee will help in placing the various problems in their proper perspective, but what we need is quick decisions and equally quick action.

May I at the outset invite your attention to the realities of the situation. The total area of India is 1,000 million acres and of this only 360 million acres are cultivated giving 0·9 of an acre per head of population. In addition every 100 acres of cultivated land had to provide fodder for 56 cattle. Further only one-fifth of the area cultivated, *i.e.*, 56 million acres are irrigated while the remaining 288 million acres depend entirely on a precarious rainfall. It is this 360 million acres which have to produce food for our entire population and provide employment.

87 per cent. of our population lives in the villages; of this one-fifth or 68 millions are landless labourers. They constitute 17 per cent. of the total population of the country.

The new times have choked the normal channels of agricultural improvement; men of light and leading who could bring enterprise and new knowledge go to towns and never return to their village homes.

A large proportion of our population is undernourished and heavily in debt and is, therefore, incapable of taking full advantage of the available resources. Sir John Megaw has pointed out that only 30 per cent. of our population is adequately nourished. According to Dr. Aykroyd a balanced diet should have, in addition to 18 oz. of cereals a day, at least 8 oz. of milk, 1½ oz. of fat, 3 oz. of pulses and 10 oz. of vegetables and fruits. It should provide 2,600 calories. If foods other than cereals are not available, 26 oz. of cereals would be needed per person per day to supply the necessary calories.

Our first and foremost need is to provide an adequate quantity of good nourishing food for all the people who inhabit this land. The requirements of the different varieties of food have to be worked out by nutrition experts. The present production is approximately known. On this basis the increased production needed can be worked out for each Province and State. It is for the Committee to propose appropriate measures to disincrease the production of foods needed and to suggest how to distribute the same so that even the poorest and the humblest worker gets what he needs and to work out a development programme on an all-India basis.

The possibilities of increasing production are: (*a*) by bringing new areas under the plough and (*b*) by carrying on more intensive agriculture.

The most important means for the development of new lands is irrigation and in some places drainage facilities for colonization, such as housing, finance, etc., are also needed. I may add that an area of no less than 250 million acres is classified as culturable waste and fallow. This area is mostly unproductive because the rainfall is scanty and there are other factors which make cultivation difficult or unprofitable. These lands await capital and

* Address delivered by the Hon'ble Sir Jogendra Singh, Member for Education, Health and Lands, Governor-General's Executive Council to the Post-War Policy Committee on Agriculture, Forestry and Fisheries.

enterprise for their development. It is for the Committee to suggest what action should be taken for the purpose.

The intensification of agriculture depends on seven factors, good cultivation, seed, irrigation, manure, drainage, bunding and crop management. This includes crop rotations and the growing of two crops in succession on the same plot of land in one year where only one crop was grown before. I am sure you will agree that Provinces and States should, in the words of Dr. Burns, plan to cut out waste of all kinds, waste of fertilising material, of water and of soil, and plan to utilise these forces to the maximum capacity.

One of our great difficulties is lack of accurate knowledge. This can only be supplied by undertaking surveys. This Committee might formulate the principles and the lines on which surveys by Provinces should be carried out regarding increasing production:—

(1) from lands already under the plough;
(2) by utilisation of lands now producing nothing, by bringing them under crops or trees or even grass.
(3) by protecting catchment areas and preventing land erosion.
(4) by extending irrigation from all the available sources.
(5) by husbanding all our indigenous sources of manure such as town refuse, farmyard litter, leaf mould, green manure, oilcake, bone-meal, etc.

It is essential to examine the whole field and lay down definite lines of investigation for the Provinces and States.

One of our most urgent needs is the production and multiplication of good seed of different kinds of crops grown. We will need nucleus seed farms for production and testing of new seeds under special officers dealing with each crop and large seed farms under good management for seed multiplication. It is large private farms that have done so much for production of seed and improvement of yields in the Punjab.

Then the greatest need in most parts of India for increasing production is water. It has to be considered as to how proper irrigation facilities can be provided for four-fifths of the cultivated area which at present depends on uncertain monsoon rainfall. At the same time it has to be determined what the policy of Government should be in respect of the financial returns from such works.

Our land has been starved and its fertility stabilised at a very low level. Proper application of manure can substantially increase yields. Dr. Burns holds that if we husband our manurial resources we can produce about one crore tons of compost manures. It may take a few years to produce fertilisers, but we can produce compost at no remote future if we start systematic work on its production. We may appoint a Sub-Committee to prepare a working plan for the production of compost, utilisation of town reufse and crushing of all the oil-seeds to increase the production of oil-cakes. It can be safely asserted that if we could provide good seed and adequate manure for all the land under cultivation and proper irrigation, we can increase the yield by 50 per cent.

We are told that milk production should be increased by 300 per cent. to meet the normal demands of our population. I am confident from the results that have been achieved that if we feed and breed our cattle and follow the laws of animal husbandry we can increase our milk supply considerably in the course of the next ten or fifteen years. "It has been observed", says Dr. Burns, "that in selected herds where systematic breeding control and extensive culling has been practised, the average yield has been increased 400 per cent. in about 25 years". The Military Dairies have shown the way; we can begin by organising civilian dairies on the same lines. We can start collective dairies in all the towns by bringing the cattle kept by the individual town dwellers under proper management. Indeed, though I see little prospect of collective agricultural farming in India which is only possible if there were more land available, I feel there is an assured prospect for collective dairies under State supervision. I feel that a Sub-Committee should examine the problem of organising collective or co-operative dairies in all the towns. I may add that the question of utilising *Gaushalas* for cattle improvement is already being examined by a Committee under the capable guidance of Sir Datar Singh.

Again, the economic aspect of production needs attention. A cultivator cannot be expected to increase productions, if the increased producion is to reduce the money value of his labour. In order to maximise production we may have to guarantee to the cultivator an assured market for his produce at a remunerative price. This is a difficult problem but it has to be faced, not only in the interest of agricultural production, but in the interest of the general economy of the country.

It is on the purchasing power of the bulk of our population that the future expansion of industry and indeed the raising of the living standard of both rural and urban population depends. It is on creating an effective and increased demand for goods that employment for nearly 68 million landless village labour can be found.

I am sure you will agree that an assured market and the maintenance of a suitable level of prices giving a fair monetary return is the most effective incentive for the producer to use all his energies to make every clod productive. It is probable that as soon as European agriculture begins to recover the period of shortage will merge into surpluses and there is a prospect of disastrous and long drawn out slump in prices such as we experienced in the thirties.

The equitable distribution of what is produced so as to ensure a sufficiency for all, particularly for agricultural and town labourers, is an equally important problem. Whatever the cost of minimum food requirements, they have to be made available to all if freedom from want is to be secured. The cost of transport is an important point in this connection. It has sometimes been suggested that transport should be treated as a Service Department

rather than as a revenue-earning proposition and that the poor and needy should be subsidised. The advice of the Committee as to how the problem of equitable distribution is to be tackled would be much appreciated.

The problem of agricultural finance and liquidation of agricultural debt is closely linked with prices. We cannot place an agriculturist in a position to make the most of his land unless we arrange to liquidate agricultural debt and arrange both short-term and long-term finance. An agriculturist cannot repay his debt because the interest he agrees to pay is beyond his capacity and his borrowing reduces him to a position of serfdom to his creditor. There is no reason why for short-term loans an agriculturist should not bring his grain to elevators or warehouses established at convenient market places, by the State and raise money at usual bank rates. If this is done and decent warehouses are established, the Reserve Bank may be prepared to make advances at usual rates of interest. The building of elevators would incidentally lead to standardisation of the produce and placing it in the best possible market.

The Co-operative movement has done a good deal of spadework and I am holding a Registrars' Conference in Bombay in August under the auspices of the Reserve Bank of India to explore further possibilities of development. In this connection the role of money-lenders who could be led to organise themselves into modern village bankers, co-operative credit societies, commercial and State Banks has to be considered.

The problem of land tenure and subdivision of holdings is inextricably mixed up with land revenue and ownership in land. These are primarily the concern of the provinces. We can, however, consider the ways and means to intensify the campaign for the consolidation of holdings. In the Punjab, on the voluntary basis, it made great headway under the inspiring leadership of my old friend, Mr. Calvert. There is a great scope for consolidation of holdings in all the provinces. It may eventually lead to what some people desire, a law to prevent fragmentation, but the Committee will have to consider whether the time for legislation has arrived or will not arrive until half of our population ceases to depend for its subsistence on land.

The master plan must take into account the demand for raw material for the growing industries of the country and production with or without processing for the export market. These will provide opportunities for developing areas which need capital, knowledge and organisation to become productive; commercial crops such as sugarcane, cotton and other fibres, tobacco, fruits and vegetables can bear higher cost of production than cereals and under scientific cultivation are capable of giving very high returns.

In my speech at the Forest Rangers' Convocation at Dehra Dun, I dwelt on the need of conserving and extending our forests and developing village forests and utilisation of our minor forest resources. Sir Herbert Howard has clearly set forth that we must have 20 to 25 per cent. of the total area as forests as a safeguard against erosion, and to supply our fuel and timber demands. This plan aims at placing another hundred thousand square miles under forest, that is, almost doubling the present area. He has shown that even where rainfall is 10 to 15 inches, trees can be grown. In Sind with irrigation, trees have been raised on almost desert lands. We have vast areas which yield nothing and which can be put under forests. Indeed to save our land afforestation is a vital necessity. This is an inter-State and inter-Provincial problem. The question of the appointment of a Land Utilisation Commission may be considered by the Committee.

Finally no progress is possible without training and recruitment of staff for carrying out plans, which may emerge as the result of our deliberations. It stands to reason that if an All-India Agricultural Policy including irrigation, forestry and land management is to be initiated and Provinces and States are to be assisted we must have an adequate Central Staff of highly qualified men who can guide and assist the Provinces in translating potential possibilities of agricultural development into actualities.

Remember it is for the first time we are taking up the problem of feeding, clothing and housing our population, in a decent manner. We have to explore the deep and mighty resources of production with sympathies which must transcend the narrowness of Provincial and inter-State boundaries. It needs the wholehearted co-operation of the Provinces and States. I think we can rely on their co-operation for no Province or State is going to refuse what is for its good. The Governing Body of the Imperial Council of Agricultural Research provides a model which may serve for creating a Central Joint Authority to carry out the policy and purpose which receives the approval of all the Provinces and States.

Our problem is to set the wheel of wealth in motion to make agricultural production remunerative, to improve the urban wage, to create demand for goods and with it new avenues of employment, thus opening out an essential and enormous field of endeavour.

I am sure in our search for material wealth we will not forfeit our spiritual heritage which, in spite of chronic poverty, has given us a measure of contentment and dignity to grace the graceless present.

I may observe in passing that our Policy Committee will formulate the lines of post-war development and these will be considered by the Government as a whole. The planning contemplated by the Committee is naturally a long-term one; such developments as are calculated to yield a material increase and are taken up immediately will merge into the long-term programme.

Now, gentlemen, let us proceed with our discussion in a businesslike manner, and determine what action should be taken to increase production and secure its equitable distribution so as to improve the standard of living of the people as well as their health and efficiency in the interest of moral and material progress of our people.

WAR AGAINST LOCUSTS IN INDIA

By HEM SINGH PRUTHI, M.Sc., Ph.D. & Sc.D. (Cantab.), F.R.A.S.B., F.N.I.
(Imperial Entomologist and Director, Imperial Agricultural Research Institute, New Delhi)

IN a previous issue of *Current Science* (Vol. X, No. 11, 1941), the writer briefly described how the current cycle of the Desert Locust started in India during 1940 and gave a brief account of progress of the outbreak up to September 1941. The present note deals with the locust movements and breeding after this period, the control organizations of the Government of India and of various Provinces and States, and India's locust activities in other countries.

Locust Situation

1941-42: Monsoon breeding in Sind-Rajputana continued up to the end of November 1941, the locust completing two generations. The local swarms which started developing about the middle of September invaded, in addition to whole of Rajputana and Sind, western parts of the Central Provinces, southern and western districts of Rajputana, Punjab and North-West Frontier Province. During October they also went as far as Belgaum in Bombay Presidency (Lat. 15° 44′, Long. 74° 43′) and Bellary in Madras (Lat. 15° 10′, Long. 76° 52′). In the beginning of October, they started flying in the westerly direction. The majority of the swarms that overwintered in India perished due to excessive cold in the Punjab and United Provinces hills and a few survivors left India *via* Upper Baluchistan during January-February 1942. After this, no swarm activity was reported from any part of India and accordingly there was no gregarious breeding during spring or early summer.

1942-43: Though there was no spring or early summer breeding in Baluchistan, but in Iran, Oman (Arabia) and other 'winter-rainfall' countries heavy breeding took place. The resultant swarms from these extra-Indian tracts commenced reaching India early in June, the earliest swarm being noted at Panjgur (Mekran-Baluchistan) on 5th. They passed over Sind and western Rajputana without egg-laying as at that time rainfall had not yet started, reached as far south as Vasna near Baroda (Lat. 23° 15′, Long. 80° 34′) on 8th July.

Soon after the middle of June, rainfall started and eggs were laid over extensive areas in eastern Rajputana, northern parts of Central India, States of Gwalior, Alwar, etc., and south-western districts of the United Provinces.

Breeding was very light in western Rajputana and in Tharpakar district of Sind. In other areas active breeding continued during July-August and energetic control operations were carried out in most parts of Rajputana except a few tracts where some hopper-bands escaped destruction and the swarm formation commenced during the first half of August. These invaded the western parts of Rajputana, Sind and Bahawalpur State. Moreover, about this time, further incursion of large number of individual locusts from west was observed and these got intermixed with the home-developed swarms. By this time western half of Rajputana, Sind and Bahawalpur had also received good rainfall and heavy breeding started in these tracts. During the second generation breeding in all areas good conrol work was carried out except in Jaisalmer and some adjoining areas, thus giving rise to a few swarms. This second brood of home-developed swarms mostly flew towards north and north-east and some flew towards west. Of the latter, about half a dozen crossed the Indian frontiers into Iran and Arabia.

A small number of swarms overwintered in northern Punjab and western Sind. Towards the end of January (1943) some swarms appeared in western Mekran (Baluchistan) and laid eggs. Oviposition also commenced in the northern Punjab in the end of January and in Sind during February. Due to thorough surveys and prompt control work hoppers were not allowed to become adults in all the areas excepting in some parts of the Punjab where a number of hopper bands escaped destruction and the resultant swarms penetrated the North-West Frontier Province and led to late spring breeding. In Mekran the pest was almost completely destroyed by the end of March but unfortunately several fresh swarms came from Persian side early in April and spread over whole of Baluchistan and laid eggs. Second generation breeding followed in western Mekran, Jhalawan, Kharan and Chagai District but the situation was soon brought under control.

1943-44: Whereas some of the immigrant swarms referred to above, that came from Persia during April, remained in western Baluchistan and laid eggs, others flew eastward and reached Kachhi and Bahawalpur areas by the end of April. During May and June they penetrated into Sind-Rajputana, western India, U.P. and Bihar, the southernmost locality reached by them was Bilaspur (Lat. 22° 07′, Long. 82° 13′) in the Central Provinces and the easternmost was Patna (Lat. 25° 41′, Long. 85° 17′). Since breeding continued in Persia up to the middle of July and a large number of hoppers escaped destruction in that country India was invaded by a second wave in the end of May and subsequent incursion of swarms was continued up to August. To some extent they were supplemented by swarms which developed in northern Punjab and N.W.F.P. in the past spring referred to above.

Localised rainfall was received after the middle of June followed by locust breeding in some parts of Jodhpur, Bikaner, Jaisalmer and Jaipur. There was widespread heavy rainfall in Sind-Rajputana beginning from 10th July

and this was followed by heavy breeding in whole of Tharparkar district, northern and western parts of Jodhpur, almost whole of Jaisalmer and Bikaner, Shekhawati desert of Jaipur and southern parts of Bahawalpur State. Some semi-desert districts of Jaipur State and Hissar district of Punjab were also affected. Towards the end of August and early in September further oviposition took place in north-eastern Bikaner, Shekhawati desert of Jaipur, Ferozepur, Hissar and Ludhiana districts, Bahawalpur, Patiala, Nabha and Loharu States in the Punjab. Energetic control work was carried out and in almost all cases the hoppers were destroyed before they passed the middle age. In spite of the fact that the breeding was very heavy, only about half a dozen small swarms developed in whole of north-west India. Most of these flew towards south-west and reached the sea coast between Karachi and Cutch State. None penetrated into Mekran or crossed the Indian frontiers. No swarm was observed in any part of India after the 12th November and presumably they got scattered or perished into the sea. Anticipating that some locust swarms in India will escape destruction and migrate to Persia in the autumn, the Middle East Anti-Locust Unit had established an organization at the Indo-Persian border to destroy such swarms. But our work in India had been so thorough that the organization had to be disbanded without coming across any swarm flying from Indian side.

In view of the foregoing, it was hoped that the locust cycle had been brought to an end in the Eastern Zone (India, Persia, E. Arabia, Iraq, etc.), by the successful control measures adopted by the Indian anti-locust organisations. Though there was no breeding during early spring (1944) in Persia or Oman active breeding had been in progress in Sudan, East Africa and Coasts of Red Sea throughout the past winter and spring. Some foreign experts assured us that India will not be invaded this year. Unfortunately, however, India was once again unexpectedly invaded by swarms from Arabia during last March-April (1944). As soil moisture conditions were very suitable in Baluchistan, they laid eggs over extensive areas in Mekran, Jhalawan, Kharan, Chagai, Lasbela and Chaman areas of the Province. In Sind also breeding is in progress in western parts, *viz.*, Dadu and Larkana Districts. The local Administrations under the supervision of Central Government staff are effectively dealing with the situation in Baluchistan and many localities have been cleared of hoppers. It is hoped that swarms will not be allowed to develop from any part except perhaps a few inaccessible valleys in Baluchistan. On the other hand, it may be mentioned that breeding is also in progress in Arabia, Persia and Afghanistan and from the available information it appears that swarms will develop from these regions and invade India in the summer.* It is feared that during the coming monsoon we shall have once again to deal with a serious situation, therefore, we have accordingly made preparations for a large-scale campaign during the next monsoon weather.

ANTI-LOCUST ORGANIZATIONS IN INDIA

As described in the previous communication (*Current Science*, Vol. X, No. 11, 1941), the present locust cycle started in 1940, a very critical time because of the war, and thus the food supply both for the troops and civil population even otherwise difficult became very serious. To fight this pest the Government of India immediately took steps. States being independent and Provinces autonomous in agricultural matters, every Province and State is responsible for the destruction of crop pests including locusts in its jurisdiction. In the past, anti-locust measures were independently undertaken by the Provinces and States affected with the result that often good work carried out by one Administration was undone through the neglect of its neighbours. This was specially so because the territories which contain the largest permanent desert breeding grounds are naturally poor agriculturally and, therefore, have little inducement to incur heavy expenditure on locust destruction. Appreciating the all-India, in fact the international importance of locust, the Central Government is maintaining since 1939 a permanent Locust Warning Organization in the charge of their Imperial Entomologist at New Delhi, with field staff posted at strategic points all over north-west India, right up to the western borders of Baluchistan. This organization continually surveys the permanent breeding areas, even when the locust is in the solitary phase, to study the rise in the population of the pest, and issue periodic warnings and forecasts about locust invasions. When the present outbreak started, this organization was suitably expanded and in addition to carrying out locust intelligence work was made responsible for directing and co-ordinating the anti-locust work of various Provinces and States in which the locust might be breeding. By the autumn of 1941 some larger measures of co-ordination of work in various Provinces and States had become necessary. Locust conferences of all the Province and States in North-west India were held in October 1941 and April 1942 and a co-ordinated locust control scheme was approvid and put in operation in May 1942. According to this scheme the cost of locust destruction in the permanent desert breeding areas was to be shared by the respective Governments of the territories that were liable to locust attacks according to an agreed formula. The participating Governments also bear the cost of special technical staff, who are stationed in various Provinces and States containing the permanent breeding grounds and who advise local authorities regarding suitable control methods to be adopted and with whose assistance the Imperial Entomologist co-ordinates control work in India as a whole. This Co-ordinated Scheme proved very successful in 1942 campaign, was renewed in 1943 with the consent of the Provinces and States concerned and has recently been again extended for the 1944-45 season. The Government of India appointed a Deputy Locust Entomologist in 1943 to ensure proper supervision of control operations and the Locust Warning Organization has been

* As anticipated swarms have invaded several States of Rajputana by the end of June.

further strengthened recently by the appointment of another Deputy Locust Entomologist.

INDIAN LOCUST ACTIVITIES IN OTHER COUNTRIES

It has already been made clear that India, Persia and Arabia are inter-dependent in regard to locust activities, since swarms developed in one country invade others. In view of this, at the request of the Middle East Supply Centre, the Government of India sent delegations of Indian entomologists for control work in Persia during 1941-42 and 1942-43, and in Arabia during 1942-43 and 1943-44. Indian troops were also employed for locust work in Persia during 1942-43 and 1943-44 where they were mainly responsible for carrying out timely control work. At the request of the Middle East Anti-Locust Unit, the Government of India took over the responsibility for carrying out control work in Persian Mekhran in February 1944. The organization is also working under the direct control of the Imperial Entomologist at New Delhi.

In addition to sending control missions described above, the Imperial Entomologist was deputed to attend an International Locust Conference at Tehran in October 1942 and again at Cairo in July 1943 where important decisions were taken with regard to the organization and technique of locust control work on international basis. To carry out well-organized work in Persia an International Control Committee was established at Tehran early in 1943 and a Government of India's representative (Superintendent, Locust Substation, Karachi) resided at Tehran for about three months during 1943 and two months during 1944, taking active part in the deliberations of the International Committee.

UNIVERSITY COLLEGE OF TECHNOLOGY, MADRAS

FACILITIES for higher technological studies in the Madras area will henceforth be available at the new University College of Technology, which is for the present located as a temporary measure in the Government College of Engineering, Guindy. The inauguration of this College is well timed as there will be a great demand for chemical engineers and technologists in the post-war era of industrial reconstructions and developments in this country. Considerable progress has already been made under the auspices of the B.S.I.R. in various branches of Chemical Industries and a number of new processes have been developed in recent years. In order to preserve this progress, and to develop further processes in a keenly competitive world in the post-war years specialised chemical engineering talent and technological grounding and skill will be in great demand. It is, therefore, a happy augury that the Madras University has pushed forward with its arrangements for contributing to meet these very essential national demands. Parallel courses in Chemical Engineering, Leather Technology, Textile Chemistry, Electrochemistry, Fermentation Technology, etc., are under contemplation, but a beginning has been made this year with the Chemical Engineering course, through the kind courtesy of the Government of Madras, who have made available to the University the vast resources of the engineering laboratories and the workshop facilities at their College of Engineering, Guindy. The College is promised a substantial financial aid by way of a munificent grant from Dr. Rm. Alagappa Chettiar, of more than Rs. 3 lakhs non-recurring, and an annual recurring grant of Rs. 25,000. The Government of Madras are also giving generous grants towards the building, equipment and maintenance of the College which has been so boldly ventured upon by the University in these difficult times from out of its own funds.

A good start has already been made with the appointment of highly qualified staff. Dr. D. R. Nanjee, who comes out shortly to India after nearly twenty years of experience in England, both in the Universities and as a Consulting Chemist, will be the Professor and Director of the College, while Dr. M. A. Govinda Rau, who has successfully organised and conducted the courses in Chemical Engineering at The Indian Institute of Science, Bangalore, will be the Reader in charge of Chemical Engineering.

Great credit is due to the learned and enthusiastic Vice-Chancellor of the University, Dewan Bahadur Dr. A. L. Mudaliar, for it was he who proposed the scheme nearly three years ago and should now be justly most happy at these successful results of his tireless efforts. We congratulate Dr. A. L. Mudaliar and the University on the occasion of the Inauguration of the new College by His Excellency the Governor on the 28th of this month. The honorary degree of Doctor of Laws will be conferred upon Dr. Rm. Alagappa Chettiar at a special Convocation held on the same occasion.

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REYNOLDS'S NUMBER AND LIQUID HELIUM II

The peculiar properties of liquid helium II which have been discovered in recent years have so far received no satisfactory explanation.* The remarkable feature of the flow of liquid helium II is the fact that it is almost independent of pressure.

If V denotes the volume-rate of flow through a capillary tube under an applied pressure difference p, then the different types of flow are distinguished by the value of n in the relation: $V = Ap^n$, where n is equal to 1 for Poiseuille's flow, ½ for turbulent flow and zero for He II flow. It is interesting to note that for the third type of flow, dimensional considerations require that the Reynolds number $u\rho D/\eta$ must remain constant, the value of this constant, of course, depending upon temperature. For this case, the velocity of flow will be inversely proportional to the diameter of the capillary tube and the volume-rate of flow will vary as the first power of the radius and not the fourth power which characterizes Poiseuille's flow.

It will be of interest to find out whether the flow of liquid helium II is really characterized by the constancy of Reynolds's number, and if such happens to be the case, it may well prove to be the simplest type of flow.

Baroda College, D. V. Gogate.
June 15, 1944.

* London, F., *J. Phys. Chem.*, 1939, p. 43.

OPTICAL CONSTANTS OF TUNGSTEN AND ANTIMONY DETERMINED BY REFLECTED POLARISED LIGHT

Experimental determination of optical constants of metals has received a quickening impulse as the result of the application of quantum mechanics to the metallic state. The present tendency has been firstly, to check the old data under improved experimental conditions; secondly, to investigate how far the polishing and contamination of surfaces are responsible for the variation in the values obtained by different workers; and thirdly, to supply the data for the metals which have not been thoroughly worked as yet. This note supplies the experimental data for Tungsten and Antimony and discusses the effect of polishing.

The experimental arrangement is that of Drude's[1] in which a beam of plane polarised light, when reflected from a metal surface, suffers a change in the state of polarisation. Locally constructed Half-shades, as suggested by L. Trontstad,[2] have been used for increasing the sensitiveness of the apparatus.

The literature on the subject[3] shows that the data for Tungsten and Antimony are few and very old. We have determined these for the range 4600 Å to 6600 Å at intervals of 200 Å and studied the variation dependent on polishing. Surfaces were prepared by taking massive metal which was rubbed flat against a file. Starting with the coarse emery paper, spread on a flat glass surface, it was ground in a particular direction so that all scratches developed in that direction only. With the next finer emery paper it was ground in a direction at right angles to the previous one. This process was continued till the finest emery paper was reached. These last fine scratches we e removed by rubbing it on a pad of old clo h covered with a paste of finely powdered aluminium oxide and held against a flat glass surface. Alternate use of magnesium oxide was also made. This process of slow hand-polishing was continued till scratches were removed. Finally, the surface was washed with soap-solution and then with alcohol to remove any trace of grease. First set of observations were made on lightly polished metallic surfaces. Same surfaces were further polished and measurements were repeated. Representative values from two such sets of measurements have been denoted by (A) and (B) respectively in Tables I and II.

TABLE I
Data for Tungsten

Wave-length in Å	nk (A)	nk (B)	n^2k (A)	n^2k (B)
6600	3·59	3·80	11·4	10·4
5600	3·12	3·49	7·23	9·22
4600	3·51	3·34	9·59	8·06

TABLE II
Data for Antimony

Wave-length in Å	nk (A)	nk (B)	n^2k (A)	n^2k (B)
6600	4·94	4·64	4·10	11·2
5600	4·06	3 88	2 69	5·16
4600	3·30	3·14	1·86	2·97

Mott[4] has concluded, after a comparison of the results of Minor, Tool and Lowery, that the crystalline metal absorbs less strongly than the amorphous polished layer. Heavier polishing produces thicker amorphous layer and consequently absorption is greater as is indicated by the increased value of n^2k. It has been further pointed out[5] that in the case of copper, as given by Lowery, nk is less sensitive to the method of polishing than n^2k (Mott uses the notations nK and K for Drude's n^2k and nk respectively). In the case of antimony exactly similar results have been obtained by us. In the case of tungsten also this tendency is clearly manifested for the majority of wavelengths, with the only difference that the lightly polished surface gave a minimum value for n^2k at 5400 Å which disappeared with the heavier polish.

Physics Department,
Science College,
Patna,
April 25, 1944.

L. M. CHATTERJEE.
K. N. PRASAD.

1. Wood, *Physical Optics*, 3rd Ed., 1934, page 542. 2. Tronstad, L., *Jour. of Scientific Instruments*, 1934, **11**, 144. 3. International Critical Tables, 1929, Ed., **5**, 248: *Landolt-Bornstein Physikalisch-Chemische Tabellen* 1923 Ed., 903. *Ibid.*, Erster *Erganzungsband*; 1927 Ed., 463. Seitz, F., *The Modern Theory of Solids*, 1940 Ed., 656. 4. Mott, N. F. and Jones, H., *The Theory of the Properties of Metals and Alloys*, 1936 Ed., 117. 5. —, *Ibid.*, 121.

A PRELIMINARY NOTE ON THE APPLICATION OF ABSORPTION-SPECTROSCOPY TO TIMBER WOOD EXTRACTS

LAST December (1943) during the War Services Exhibition held at Nagpur, a conversazione was arranged by the local Science College. There we witnessed certain interesting demonstrations on Spectroscopy, Raman Effect, and Irradiation of Chemical Substances under cathode rays, etc. It then occurred to us why we should not employ spectroscopy for the elucidation of our problem, namely, that of the Identification of Timber Woods.

The problem was discussed with Dr. A. S. Ganesan of the Physics Department of the Science College (Nagpur) and he very kindly offered to take spectrographs of the absorption-spectra of iron in relation to water extract of timber woods.

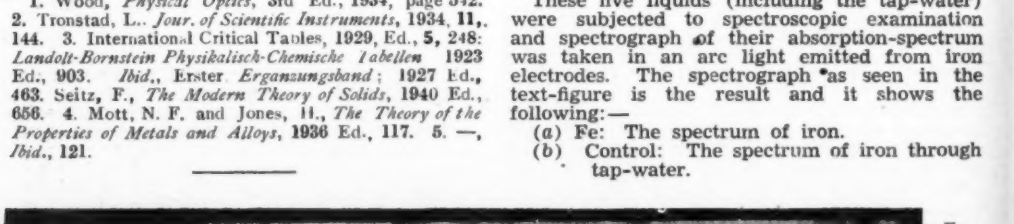
We then approached Mr. Haji Fazal, a well-known furniture-maker and timber merchant of Nagpur, and he very kindly placed at our disposal for experiment the following four important timber woods commonly employed in the manufacture of funrniture:—

(1) *Bija* or *Bijasaal* (*Pterocarpus marsupium* Roxb. (Leguminosæ).
(2) *Sagwan* or Teak (*Tectona grandis* Linn.) (Verbenaceæ).
(3) *Siwan* (*Gmelina orborea* Roxb.) (Verbenaceæ).
(4) *Salai* (*Boswellia serrata* Roxb.) (Burseraceæ).

Thin fine shavings of each of the specimens aforesaid were taken off by planing. Equal quantities of these were separately boiled in equal volume of tap-water for fifteen minutes each, in glass beakers and they were subsequently allowed to cool down. Thereafter each one of them was separately filtered through fresh filter-paper and the filtrate collected in glass beakers. The tap-water, being the mother-liquor in each case, was, therefore, taken separately and was marked as Control. We had thus five samples of liquids for our experiment.

These five liquids (including the tap-water) were subjected to spectroscopic examination and spectrograph of their absorption-spectrum was taken in an arc light emitted from iron electrodes. The spectrograph as seen in the text-figure is the result and it shows the following:—

(*a*) Fe: The spectrum of iron.
(*b*) Control: The spectrum of iron through tap-water.



(*c*) 1: The spectrum of iron through filtered tap-water extract of wood shavings of *Bija* or *Bijasal* (*Pterocarpus marsupium* Roxb.)

(*d*) 2: The spectrum of iron through filtered tap-water extract of the wood shavings of *Sagwan* or teak (*Tectona grandis* Linn.)

(*e*) 3: The spectrum of iron through filtered tap-water extract of the wood shavings of *Siwan* (*Gmelina arborea* Roxb.)

(*f*) 4: The spectrum of iron through filtered tap-water extract of the wood shavings of *Salai* (*Boswellia serrata* Roxb.)

It will, thus, be seen that the absorption-spectrum in each case is very clear and characteristic gradually fading and disappearing in varying degrees towards the violet end of the spectrum. In *Pterocarpus marsupium* Roxb. (text-figure 1) the quantum of absorption is remarkably great, whereas *Gmelina* arborea Roxb. (text-figure 3) surprisingly enough shows a discontinuous phenomenon of absorption in its spectrum. The other two, namely, *Tectona grandis* Linn. (text-figure 2) and *Boswellia serrata* Roxb. (text-figure 4), display characteristic absorption of their spectra in varying degrees.

The experiment was repeated several times even (*a*) with tap-water extracts taken from different specimens of the same species of timber-wood, and (*b*) with concentrated tap-water extracts of the very same four species of timber-wood under study, but the result in each case was found to be invariably always in close conformity with the findings of our very first spectrograph.

The study has, by now, been extended to two other species of wood, namely, of *Neem* (*Azadirachta indica* A. Juss.) (Meliaceæ) and of *Santra citrus suntara Engl.* (Rustaseæ). Here also the absorption-spectra are specific for each of them.

Further study and investigation are in progress.

We wish to record our sincerest thinks to Dr. A. S. Ganesan, Physics Department of the Science College, Nagpur, for his valuable help, to Mr. H. S. George, Chief Conservator of Forests, C.P. and Berar, Nagpur, for very kind and ready permission to make a free use of his Departmental Library, and to Mr. Haji Fazal, Nagpur, for his generous offer of the specimens of timber-woods for our experiments.

(Miss) R. Shah.
T. C. N. Singh.

Horticulaural Research Institute,
Nagpur—Ajni, C.P.,
June 11, 1944.

CURRENT BEDDING AND TECTONICS

In a recent letter to *Current Science*[1] Professor Rode objects to my use of the disposition of current-bedded structures in determining the stratigraphical and tectonic sequence of the Central Himalaya,[2] on the grounds that the method is of doubtful value when applied to disturbed rocks. It is only in the study of disturbed rocks, however, that there is any need to use bedding textures and structures in fixing the stratigraphical order. In undisturbed regions the sediments are normally accepted as lying in their original order of deposition. The current-bedding method has been extensively employed in Northern Europe,[3] and, apart from the Himalayan region now under question, has been adopted by C. S. Pichamuthu in his study of the Archæan rocks of the Chitaldrug Schist Belt.[4] Not only are such structures preserved in areas of complex thrusts and overfolds, but they may be recognised in rocks which have undergone the effects of meso-grade metamorphism.[5] I have seen them in many places in the garnet-biotite-quartz granulites of the Main Himalayan Range.[6] For the preservation of such structures it is only necessary that strong shearing stress or excessive soaking should not have been operative in the rising and ebbing tide of metamorphism.

In the case of the Tal rocks of the Central Himalaya, we are not concerned with any possible obliterating effects of metamorphism on bedding structures. Apart from very local crush effects, the Tal rocks in the basins between longitudes 77° 30′ and 79° are not metamorphosed, although there has been selective silicification of some of the sandstones as compared with the shales, due to the greater permeability of the sandstones to solutions carrying silica. The Tal quartzites and sand-

FIG. 1. Curremt-bedded Upper Tal quartzites. Map No. 53 J/3 (30°22′30″:78° 9′30″). Feb. 1936

FIG. 2. Current-bedded Upper Tal sandstones. Map No. 53 J/3 (30°4′:78° 30′). May 1936.

stones possess, unequivocally preserved, excellent current-bedded and ripple-marked structures. The former have proved that the Upper Tal arenaceous rocks, and the Lower Tal shales into which they grade downwards, are not inverted. Two photographs of current-bedding in the Tal quartzites and sandstones are submitted with this letter, in both examples the concave sides of the current-bedding planes facing upwards towards the Tal limestone and, in the Ganges section, the overlying Nummulitic series.

Although it is not necessary in areas removed from orogenic zones to prove the correct order of deposition, current-bedding sometimes provides useful information about palæogeographical conditions. The Vindhyan system of Peninsular India offers an interesting study by this method.[7]

Geological Survey of India,
Calcutta, J. B. AUDEN.
May 11, 1944.

1. *Current Science*, 1944, **13**, 74. 2. *Rec. Geol. Surv. Ind.*, 1933, **67**, 392. 3 *Geol. Mag.*, 1930, **67**, 68–92. British Regional Geology: The Grampian Highlands, 1935, 29. 4. *Curr. Sci.*, 1937, **6**, 95. 5 Die Gesteinsmetamorphose (Grubenmann-Niggli), 1924, 62. 6. *Rec. Geol. Surv. Ind.*, 1935, **69**, 135. 7. *Mem. Geol. Surv. Ind.*, **62**, 1933, 216.

ASSAY OF FERRI SUBCHLORIDUM CITRATUM, B.P.

THE method recommended by the B.P.[1] for the assay of ferri subchloridum citratum consists in dissolving an accurately weighed quantity of the powder in dilute sulphuric acid and determining the ferrous iron in the solution by titration with standard potassium dichromate, using a solution of potassium ferricyanide as external indicator. C. G. Lyons and F. N. Appleyard[2] have shown that the official method gives results which are appreciably too high. They have recommended the use of ceric sulphate in place of potassium dichromate for the titration of the ferrous iron. Phenyl anthranilic acid or ferrous o-phenanthroline ion have been recommended as internal indicators. Other indicators were tested and found to be less suitable. C. G. Lyons and F. N. Appleyard[3] have also found that in the assay of saccharated iron carbonate by titration with dichromate, cane-sugar interferes by giving too high results. C. Morton and D. C. Harrod[4] also observed the interference of carbohydrates in the determination of ferrous iron by titration with potassium dichromate, using either potassium ferricyanide as the external indicator or diphenyl amine as the internal indicator. They recommended the employment of Heisig's[5] method in such circumstances. C. R. Viswanadham and G. Gopala Rao[6] have found that oxalic, tartaric, and citric acids interfere in the titration of the ferrous iron by dichromate, using both the internal and external indicators. They have explained the phenomenon on the basis that the reaction between ferrous salts and dichromate induces the reaction between dichromate and organic acids like oxalic, tartaric and citric acids.

We have now found that an accurate assay of ferri subchloridum citratum is possible by using sodium vanadate as the oxidizing agent in place of potassium dichromate for the titration of the ferrous iron. A decinormal solution of sodium vanadate is prepared and standardised as follows: The requisite quantity of pure ammonium vanadate, "Merck", is weighed out into a conical flask, distilled water added, together with a slight excess of pure sodium carbonate and boiled to drive off the ammonia completely. The resulting solution of sodium vanadate is transferred to a measuring flask and made up to the mark. We found that a solution of sodium vanadate made in this way keeps quite well. An aliquot volume of standard (decinormal) ferrous ammonium sulphate solution is taken in a beaker, 0·5 c.c. of a 0·1 per cent. diphenylamine indicator solution and 2 to 3 c.c. of phosphoric acid are then added followed by 10 c.c. of 4 N sulphuric acid. The ferrous solution is then titrated with the sodium vanadate solution, run from the burette until a permanent blue-violet colour results. The solution may suitably be diluted. A correction of 0·3 c.c. of N/10 vanadate solution to be subtracted from the titre is to be applied for 1 c.c. of 0·1 per cent. indicator solution.

In the following tables we record the results of the determination of ferrous iron in admixture with citric acid in about the same proportions as in ferri subchloridum citratum, under

TABLE I

Amount of ferrous iron taken = 0·0431 gm.

Amount of citric acid added	Amount of ferrous iron found by the official method (dichromate titration)	Amount of ferrous iron found by the authors' method (vanadate titration)
0·0 875 gm.	0·0470 gm.	0·0431 gm.
0·017 0 ,,	0·0504 ,,	0·0429 ,,
0·03500 ,,	0·0560 ,,	0·04 1 ,,
0·10500 ,,	0·0683 ,,	0·0428 ,,
0·17500 ,,	0·0730 ,,	0·0433 ,,

TABLE II

Amount of citric acid added = 0·0350 gm.

Amount of ferrous iron taken	Amount of ferrous iron found by the official method	Amount of ferrous iron found by the authors' method
0·02155 gm.	0·0339 gm.	0·02150 gm.
0·04310 ,,	0·0593 ,,	0·04310 ,,
0·06465 ,,	0·0825 ,,	0·06480 ,,

the same conditions as prescribed in the B.P. as also in different proportions by titration with a decinormal solution of dichromate using the external indicator, and those obtained by titration with the sodium vanadate with diphenylamine as the internal indicator.

From the results given in Tables I & II, it will be seen that the amount of ferrous iron found by the official method is always in excess of the quantity actually present and this varies with the variation in concentration of both the ferrous iron and the citric acid. On the other hand, the determinations made by the authors' method gave accurate values. Titration with sodium vanadate is thus found to be quite accurate and convenient for the assay of ferrous iron in the drug ferri subchoridum citratum. Unlike the method proposed by C. G. Lyons and F. N. Appleyard, the authors' method employs the common laboratory reagent diphenylamine as the internal indicator.

Andhra University, G. Gopala Rao.
May 20, 1944. C. R. Viswanadham.

1. *British Pharmacopœia*, 1932. *First Addendum*, 1933, 33-34. 2. Lyons, C. G., and Appleyard, F. N., *Quart. J. Pharm.*, 1937, **10**, 348. 3. —, —, *Ibid.*, 1936, **9**, 462. 4. Morton, C, and Harrod, D. C., *Ibid.*, 1936, **9**, 480. 5. Heisig, G. B., *J, Amer. Chem. Soc.*, 1928, **50**, 1687. 6. Viswanadham, C. R., and Gopal Rao, G., *Curr. Sci.*, 1943, **12**, 327.

CHEMICAL COMPOSITION OF BOMBAY SHARK LIVER OIL

Niyogi *et al.* (1941),[1] (1943)[2] have found by tintomtric and biological methods that the liver oils of some of the fish available in Bombay coastal waters are considerably richer in vitamin A than cod liver oil. Since Indian shark liver oils are now on market as substitutes for cod liver oil, it was considered desirable to investigate the chemical composition of the oil obtained from Bombay shark of the following description:

Local name—Mushi; scientific name—*Scoliodon Sorra Kowah*; Class—*Chandropterygia;* sub-class—*Plagioston*; order—*Galea;* sub-order —*Carcharinida*; family—*Carchariniidæ*; species —*Scoliodon.*

The dimensions of the shark vary from between 30 inches to 60 inches long to between 15 inches to 20 inches broad. The livers weigh from 250 grams to 1,500 grams. The oil was obtained by grinding the minced livers with anhydrous sodium sulphate and extracting repeatedly with ether. The ether was finally distilled off and the residual oil used for analysis. The yield on the weight of the livers is about 50 per cent. of yellowish oil which, on standing, deposits stearin.

The physical and chemical constants of the oil, determined by the usual methods are given in Table I.

TABLE I

Specific gravity at 59° C.	0·9187
Ref. Index at 52° C.	1·4660
Solidifying point	21° C.
Melting point	36° C.
Acid value	0·9
Saponification value	190·9
Iodine value (wij's)	93·3

The oil was saponified with alcoholic potash and the unsaponifiable matter extracted with ether. The fatty acids liberated and purified in the usual way, gave the following constants.

TABLE II

Per cent. of mixed fatty acids	91·6
Ref. Index at 52° C.	1·4520
Titre value	37·2° C
Neutralisation value	201·7
Mean molecular weight	278·8
Iodine value (wij's)	90·3
Per cent. of unsaponifiable	2·87
Iodine value of unsaponifiable (wij's)	173·2

Separation of Fatty Acids

The mixed fatty acids were then separated into saturated and unsaturated acids by Twitchell's method (1921).[3] Table III gives their analytical values.

TABLE III

Acids	% in mixed acids	Iodine value (wij's)	Mean molecular weight
Saturated	42·3	11·0	252·0
Unsaturated	57·7	149·5	264·4

Following the method evolved by P. Ramaswami Ayyar and collaborators in these laboratories (unpublished work of P.R.A.) for a more complete separation of unsaturated and saturated fatty acids, six fractions of lead salts were thus obtained:—

Fraction 'A'—lead salts insoluble in boiling hot 95 per cent. alcohol which are further separated by ether into (1) ether-soluble salts—A_1 and ether-insoluble salts—A_2.

Fraction 'B'—lead salts insoluble in the cooled 95 per cent. alcoholic filtrate from fraction 'A' which are further separated by ether into (1) ether-soluble salts—B_1 and (2) ether-insoluble salts—B_2.

Fraction 'C'—lead-salts soluble in the cooled 95 per cent. alcoholic filtrate from fraction 'B' which are further separated by ether into (1) ether-soluble salts—C_1 and (2) ether-insoluble salts—C_2.

Fatty acids were liberated from all these six fractions and their analysis is given in Table IV.

TABLE IV

Acids from fraction		%	Iodine value (wij's)	Eq. wt.
A	A_1	3·8	115·2	237·7
	A_2	4·3	12·5	248·6
B	B_1	7·7	117·5	227·9
	B_2	34·9	10·5	265·3
C	C_1	46·4	156·3	272·0
	C_2	..	..	..

The liquid acid fractions were then examined quantitatively by the Bromination method outlined by Lewkowitsch[4] and the results are summarised in Table V.

TABLE V

Bromination of liquid acids

	Ether insoluble Bromides	Petrol insoluble Bromides	Petrol soluble Bromides
Fraction A_1 3·8%			
% of A_1 acids which yield	5·4	7·3	87·3
% of bromine in the bromides	69·95	46·6	35·0
M.pts. of the bromides	Chars at 250° C.	..	liquid
Fraction B_1 7·7%			
% of B_1 which yields	3·5	5·0	91·5
% of bromine in the bromides	70·0	37·5	35·3
M.pts. of the bromides	Chars at 250° C.	..	liquid
Fraction C_1 46·4%			
% of C_1 which yields	12·4	10·6	77·0
% of bromine in the bromides	69·8	66·9	43·05
M.pts. of the bromides	Chars at 250° C.	120–35° C.	liquid
Neutralisation equivalent	918·5	..	..

The main fraction of solid acids liberated from B_2—lead salts were crystallised from 70 per cent. alcohol with an yield of 73 per cent. (m.p. 60° C., saponification equivalent 256·7).

SUMMARY

The Bombay shark liver oil has been analysed and its fatty acids separated into saturated and unsaturated components. The bromides of the latter have been prepared and analysed. The unsaponifiable matter is highly unsaturated.

My thanks are due to Prof. P. C. Guha for his kind encouragement, to Mr. P. R. Ayyar for his guidance and to (Miss) M. R. Varde for classifying the shark.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore, (MISS) INDIRA GAJJAR.
July 15, 1944.

1. *Indian Journal of Medical Research*, 1941, **29**, 279. 2. *Ibid.*, 1943, **31**, 15. 3. *Ind. Eng. Chem.*, 1921, **13**, 806. 4. Lewkowitsch, "Chem. Tech. and Analysis of Oils, Fats and Waxes", 6th Edition, Vol. I, 585.

ANTIBACTERIAL AGENTS IN FLOWERS

THE works of Flemming (1929), Dubos (1939) and others definitely show that antibacterial agents can be isolated from fungi and bacteria. The subject has been ably reviewed by Waksman (1941). In a previous paper, one of us (1941) detected antibacterial agents in some crude bacterial extracts. In a recent paper Osborn (1943) has shown that such substances exist in certain green plants. Empirically flowers in various ways have been used in the treatment of diseases in this country. In this paper, we are recording our work, where we tried to find out whether antibacterial substances could be isolated from flowers. We could not make a large selection, but had to depend upon those available at our private grounds.

Extracts were made in four different ways:—(1) Water, (2) hydrochloric acid in methyl alcohol, (3) dilute ethyl alcohol and (4) glacial acetic acid.

Large quantities of flowers were dried at room temperature in the dark. These were powdered and finally extracted. The extracts were finally dried *in vacuo* at room temperature and the fine deposits used for the tests.

10 mgm. of the deposits were added to 10 c.c. of nutrient broth with 2 per cent. agar. Final pH adjusted to 7·2 and poured into 2" diameter petri plates. Four quadrants were marked out and smeared with a young culture of the following organisms: *B. typhosus, B. coli, V. cholera* and *Staphylococcus aureus.*

The plates were incubated at 37° C. for 24 hours. The table below gives the results.

From the table, we find that the best inhibition was found with glacial acetic acid exracts. Whether this was due to antibacterial agents or other factors should be investigated. The watery extract proved negative. Selective inhibition was found with the acid methyl alcohol and ethyl alcohol extracts. The results are highly suggestive. We have not identified the active agents in the different fractions.

Organisms	Nature of extract	Rose (*Rosa damascena* N.O. Rosaceæ) Pink and Yellow	Mary Gold (*Tagetes erecta* N.O. Compositæ)	Canna (*Canna indica* N.O. Scitaminaceæ yellow, orange, pink and red)	Hibiscus (*Rosa Sinensis* N.O. Malvaceæ)	*Bignonia venusta*
B. coli	Glacial acetic acid	−	−	−	+	+
B. typhosus		−	−	−	−	−
V. cholera		−	−	−	−	−
Staphylo aureus		−	−	+	+	+
B. coli	Water	+	+	+	+	+
B. typhosus		+	+	+	+	+
V. cholera		+	+	+	+	+
Staphylo aureus		+	+	+	+	+
B. coli	Ethyl alcohol	+	+	+	+	+
B. typhosus		+	+	+	+	+
V. cholera		−	−	+	+	+
Staphylo aureus		+	+	+	+	+
B. coli	Hydrochloric acid and methyl alcohol	+	+	+	+	+
B. typhosus		+	−	+	+	+
V. cholera		−	+	+	+	+
Staphylo aureus		+	+	+	+	+

\+ Growth.
− No growth.

The work requires more elaborate investigation for further informations.

Pharmacology Section,
Department of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
December 10, 1943.

B. K. Bhattacharya.
S. P. De.

1. Dubos, R. J., *Jr. Exp. Med.*, 1939, **70**, 1. 2. De, S. P., *Cal. Med. Jr.*, 1941, **38**, 397. 3. Flemming, A., *Br. Jr. Exp. Path.*, 1929, **10**, 226. 4. Osborn, E. M., *Ibid.*, 1943, **24**, 227. 5. Waksman, S. A., *Bact. Rev.*, 1941, **5**, 231.

INDUCING FLOOD RESISTANCE IN PADDY BY PRE-SOWING TREATMENTS

Experiments with a view to inducing flood resistance in paddy by pre-sowing treatments have been carried out in this laboratory for the last six years under the auspices of the Imperial Council of Agricultural Research. The basis of pre-sowing treatment has been to anticipate the deficiency of factors which plants experience in flood and to subject the activated germinal plants to such deficiency. Thus in the case of the paddy, the flooded plant presumably experiences deficiency of oxygen and light. In ordinary agricultural practice the activated germ of the paddy is subjected to light restriction under the soil but it has free access to oxygen. In our experiments the pre-sowing treatment consists in subjecting the activated germ to a period of anaerobiosis. Such treatment has been given at ordinary laboratory temperature (30°-32° C.) and then one set is subjected to low temperature (2°-5° C.).

After germination and transplantation the plants are subjected to submersions as described below. The results have been promising and the experiments are being conducted on a larger scale and according to statistical requirements. Last year's (1943-44) experiments were planned according to a statistical design suggested to us by the Statistical Laboratory of Professor Mahalanobis. The results having been encouraging are reported here.

Seed Materials—

(*a*) F. R. 27 A of Cuttack Farm — Winter paddy grown in flooded areas.
(*b*) C. No. 3 of Cuttack Farm — Winter paddy grown in normal areas.

Pre-sowing Treatments—

(i) *Low temperature* (*LT*).—Germinated seeds from both the varieties were placed in a kelvinator at 2°-5° C. for 6 days.

(ii) *Anaerobiosis* (*An*).—Another lot of the germinated seeds was kept in a continuous current of oxygen-free air for 3 days.

(iii) *Low temperature and anaerobosis*.—A third set of the seeds was first subjected to anaerobiosis treatment for 3 days as above and then to low temperature for another 3 days.

(*iv*) *Control* (*C*).—No treatment.

These treated and control seeds were sown in separate seedling pots and later transplanted to bigger pots with four plants of the same treatment in each pot. The pots were divided

into two sets and both the sets were submerged under water in a cemented tank (which contained clear water) one lot being submerged after 60 days from sowing and the other after 85 days. In each set there were three periods of submersion:

(*a*) Submerged for 15 days.
(*b*) Submerged for 20 days.
(*c*) Submerged for 25 days.

Thus the experiment consisted of all combinations of two varieties, four pre-sowing treatments, two ages of seedlings and three periods of submersion. There were three replications, making a total of 144 pots with four plants in each pot. The pots were submerged in the tank in a randomised manner according to a statistical design supplied by the Statistical Laboratory, Calcutta.

At the termination of each period of submersion the pots were taken out of water and they were first kept in a shady place for 3 days and later removed to the sun. The number of plants survived was recorded one month after removal from water. This time limit had to be fixed because soon after removal from water it was impossible to say whether a particular plant would survive or not due to its wilted and shrivelled appearance, and sufficient time had to be given to the plants to show signs of life, such as putting forth new leaves and tillers. The number of plants which flowered and their yield were also recorded and the data are presented in Tables I and II.

From the tables the order of survival, flowering and yield is as follows:

Var. F. R. 27. A—

Survival: Age = 60 days − LT* + An > An† > LT > C‡
" = 85 days − LT + An > An > LT > C
Flowering: Age = 60 days − An > LT + An > LT > C
Age = 85 days − LT + An > An = LT > C.
Yield: Age = 60 days − An > LT > LT + An > C
Age = 85 days − An > LT > C > LT + An

Var. C. No. 3—

Yield: Age = 60 days − LT + An > LT > An > C
Age = 85 days − LT + An > C > LT = An

* Low temperature † Anaerobiosis ‡ Control

From the results given above the general conclusion can be drawn that all the treatments are superior to the control in so far as survival, flowering and yield are concerned, that is to say, pre-sowing treatment does induce resistance to flood. It appears that anaerobiosis treatment alone or in combination with low temperature seems to be consistently the best treatment in the case of variety F.R. 27 A. In the case of C No. 3 which has no reputation as a flood-resistant variety, only a few plants survived on submersion, as evident from Table II. But even here, the results suggest the probable favourable effect of the treatments. It remains to be seen whether the treated plants of this variety can withstand submersion to a greater extent by increasing the duration of the treatment. The experiment is being repeated this year on the same lines.

The data collected in this experiment are being statistically analysed at the Statistical Laboratory, Calcutta, and we are very much indebted to Professor P. C. Mahalanobis for

TABLE I

Variety F. R. 27 A.

Treatments	15 days submersion				20 days submersion				25 days submersion				Total survived	Total flowered	Total yield of grains (gm.)
	No. submerged	No. survived	No. flowered	Yield of grains (gm.)	No. submerged	No. survived	No. flowered	Yield of grains (gm.)	No. submerged	No. survived	No. flowered	Yield of grains (gm.)			
AGE–60 DAYS															
Low temperature ..	12	9	9	26·32	12	10	10	26·22	12	5	5	5·78	24	24	58·32
Low temperature + anaerobiosis ..	12	12	12	29·04	12	10	7*	10·87	12	6	6	16·17	28	25	56·08
Anaerobiosis ..	12	11	11	25·79	12	11	11	21·50	12	5	5	13·14	27	27	60·43
Control ..	10	8	7	18·80	12	7	6	13·29	12	2	2	7·90	17	15	39·99
TOTAL ..	46	40	39	99·95	48	38	34	71·88	48	18	18	42·99	96	91	214·83
AGE–85 DAYS															
Low Temperature ..	12	11	10	9·51	12	8	8	14·26	12	8	8	10·17	27	26	33·94
Low temperature + anaerobiosis ..	12	11	11	12·73	12	10	7	7·57	12	9	9	6·07	30	27	26·37
Anaerobiosis ..	12	12	12	22·10	12	8	6	9·58	12	8	8	8·25	28	26	39·93
Control ..	12	8	8	17·77	12	4	3	8·06	12	3	1	1·19	15	12	27·02
TOTAL ..	48	42	41	62·11	48	30	24	39·47	48	28	26	25·68	100	91	127·26

* 2 plants which survived were destroyed by white-ants.

TABLE II

Variety C. No. 3

(No. of plants submerged for each period = 12)

Treatments	15 days submersion			20 days submersion			25 days submersion			Total survived	Total flowered	Total yield of grains (gm.)
	No. survived	No. flowered	Yield of grains (gm.)	No. survived	No. flowered	Yield of grains (gm.)	No. survived	No. flowered	Yield of grains (gm.)			
						AGE–60 DAYS						
Low temperature	3	3	5·46	..	..	..	..	..	..	3	3	5·46
Low temperature + anaerobiosis	3	3	6·98	..	..	..	..	..	..	3	3	6·98
Anaerobiosis	1	1	5·39	..	..	..	..	..	..	1	1	5·39
Control	..	..	..	..	..	..	..	..	..	..	..	..
						AGE–85 DAYS						
Low temperature	..	..	..	..	..	..	..	..	..	..	..	..
Low temperature + anaerobiosis	1	1	3·5	..	..	..	1	1	2·0	2	2	5·5
Anaerobiosis	..	..	..	..	..	..	..	..	..	..	..	..
Control	2	2	2·01	..	..	..	..	..	..	2	2	2·01

having undertaken the work. The design of the experiment was also supplied from the Statistical Laboratory, Calcutta, and our thanks are due to Mr. K. R. Nair for this. We are indebted to the Imperial Council of Agricultural Research for a grant which has made the experiments possible.

Botanical Laboratory,
Ravenshaw College,
Cuttack,
June 22, 1944.

P. PARIJA.
K. P. PILLAY.

A SHORT NOTE ON VERNALIZATION OF GRAM (*CICER ARIETINUM* L.)

PAL and Murty[1] in their studies on vernalization of certain crop plants found that low temperature vernalization induced earlier flowering in two out of four varieties of gram tested. Kar[2] has reported that pre-sowing cold treatment has no effect in shortening the flowering period in gram and other crops studied. A preliminary experiment was conducted here with a view to studying whether pre-sowing low temperature treatment would induce earlier flowering and higher yield in gram under Orissa conditions, and the results obtained in this connection are briefly reported below. Seeds of uniform size of variety Sabour type 4 were soaked in water for 22 hours at room temperature to initiate the dormant embryo into activity. The swollen seeds were placed in a kelvinator at 0°-2° C., one lot for 7 and another for 14 days. A set of untreated seeds was previously soaked in water to bring them to the same stage of development as the treated. Both treated and untreated were sown in separate pots on 3-12-1943 (20 pots for each treatment) with one seed in each pot. The treatment was adjusted in such a manner that the sowing was done on the same day. At the time of sowing it was observed that plumules had protruded by an average of 5 mm. in seeds vernalized for 14 days and by 3 mm. in those vernalized for 7 days and in the controls, the plumules had just emerged out of the seed-coat. The pots were arranged in an open space of the Botanical Gardens under identical conditions of light. The heights of the plants after 40 days are given below:—

Vernalized, 14 days—18·36 cms.*
Vernalized, 7 days—18·05 cms.*
Control—18·23 cms.*

(* Each value is the mean of 20 plants.)

The analysis of variance gives a small variance ratio which is insignificant and thus we might say that vernalization has no effect on the vegetative growth of the plant.

In order to study whether any earliness in flowering is induced following low temperature vernalization, the following observations were taken:—

(i) Appearance of first flower buds.
(ii) Opening of first flower.
(iii) Formation of first fruit.

The dry weight of the pods, which represents the yield, and the dry weight of the stem were also recorded. The entire data are given in Table I.

The data are analysed statistically and the results of the analysis are given in Tables II and III.

The results indicate that plants vernalized for 14 days flower 3 days earlier than the control ones (Table I), the difference being found to be statistically significant (Table II). There is no significant difference between the two periods of vernalization. The difference between vernalized and control plants with regard to dry weight of pods and dry weight of stem is statistically insignificant (Table III).

I have great pleasure to acknowledge my deep indebtedness to Principal P. Parija, for his kind help, valuable suggestions and helpful

TABLE I
Mean values

Treatments	Number of days taken for			Dry weight of pods	Dry weight of stem
	formation of flower buds	opening of flowers	formation of fruits		
Vernalized 14 days	41·40	47·15	51·85	0·293	0·976
,, 7 days	41·57	48·53	52·43	0·401	1·064
Control	44·69	50·67	55·33	0·280	1·0.8

TABLE II
Analysis of variance

Variance	Appearance of flower buds				Opening of flower				Formation of fruits			
	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F
1	2	3	4	5	6	7	8	9	10	11	12	13
Between treatment ..	2	58·255	7·87	3·174	2	53·105	4·125	3·178	2	51·50	4·915	3·19
Within treatment ..	52	7·401			51	12·873			48	11·496		

TABLE III
Analysis of Variance

Variance	Dry weight of stem				Dry weight of pods			
	D.F.	M. square	F	5% F	D.F.	M. square	F	5% F
1	2	3	4	5	6	7	8	9
Treatment	2	0·03725	0·348	3·174	2	0·05633	2·137	3·254
Error	52	0·10686			37	0·02636		

criticisms. I am thankful to Professor P. C. Mahalanobis for analysing the data statistically at his laboratory, and to Dr. R. H. Richaria, Economic Botanist, Bihar, for the supply of seeds.

Botanical Laboratory,
Ravenshaw College,
Cuttack, K. P. PILLAY.
June 22, 1944.

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THE ORIGIN OF THE HAUSTORIA IN THE VALUE OF *LOBELIA*

DR. G. O. COOPER (1942) has recently published a paper on the embryology of *Lobelia cardinalis* L., in which it is stated that the synergids and antipodal cells function as micropylar and chalazal haustoria respectively. The only recent work on the Lobeliaceæ and Campanulaceæ, referred to by him, is that of Kausik (1938) on *Lobelia nicotianæfolia*. Dr. Cooper has evidently missed the papers of Rosén (1932), Kausik (1935), Hewitt (1939) and some others, a study of which clearly indicates that the occurrence of haustorial synergids and antipodal cells would be most unexpected in the family.

In the absence of any material of *L. cardinalis* and the improbability of securing it for the duration of the war, the writer sectioned *L. trigona* Roxb., which is available locally. The result of this study confirms Dr. Kausik's interpretation that the haustoria (both micropylar and chalazal) originate from the endosperm and have nothing to do with the synergids or antipodal cells, which degenerate at the time of fertilisation.

It appears, however, that Dr. Kausik is not quite correct about the exact origin of the chalazal haustoria. According to him the primary chalazal cell, formed after the first division of the endosperm nucleus, divides longi-

tudinally and the two resulting cells directly produce the chalazal haustoria. My observations show that both of these cells undergo at least one transverse division and only the lower pair becomes haustorial, the upper contributing to the endosperm proper. Hewitt's (1939) observations seem to me to be more correct in this respect. He says that two cells at each end of the *eight-celled* endosperm develop into large micropylar and chalazal haustoria, the remaining four cells developing into the large central mass of endosperm.

I am grateful to Dr. S. B. Kausik (Bangalore) for a loan of some of his preparations of *Lobelia trigona*. The observations recorded here on the origin of the chalazal haustoria are, however, based on my own material as I did not find the requisite stages in Dr. Kausik's slides.

Botany Department,
Dacca University, P. MAHESHWARI.
April 28, 1944.

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A PRELIMINARY NOTE ON A FRESH-WATER ENTOPROCTAN DISCOVERED IN ANNAMALAINAGAR, S INDIA

THE Entoprocta (Calyssozoa[1] or Kamptozoa[2]) are almost all marine. Two genera, *Loxosomatoides*[3] and *Chitaspis*[4] live in brackish water. The only representative in freshwater is *Urnatella* which has been found in the neighbourhood of Philadelphia,[4] U.S.A., and nowhere else in the world. It will be of great interest, therefore, to report the occurrence of a freshwater Entoproctous Polyzoan in Annamalainagar, S. India. Several specimens of this animal were collected by me a few months back, and many of them have since been under observation in the living condition in aquaria in the laboratory. I have examined a few specimens after staining and mounting, as well as in sections. I have also deposited with the Zoological Survey of India a few specimens in spirit and in mounts.

The general appearance of the animal is represented in Fig. 1. Like *Urnatella* the animal is colonial and possesses a jointed stalk with a horny covering. The colonies are about 1 mm. in height. The segments of the stalk, which are capable of functioning as resting buds as in *Urnatella*,[5] are not more than seven in number, whereas in *Urnatella*[6] there may be as many as eighteen segments in the cœnœcium. The base of the stalk has a horny disc-like expansion by means of which it is attached to the substratum. The stalks may arise singly or in clusters of two or more. In the latter case they do not have a common base as in *Urnatella*,[6] but each stalk has its own distinct base which is joined to that of the adjacent one, the bases of several stalks thus presenting together the appearance of a jointed structure.

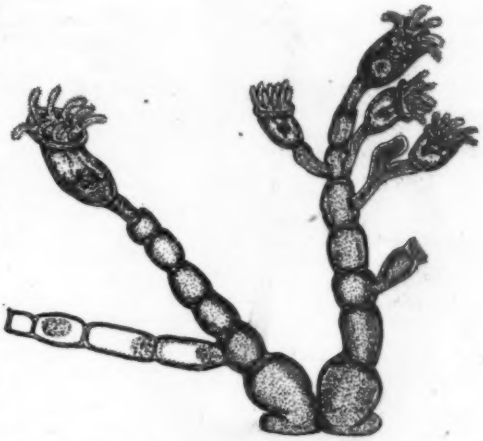

FIG. 1.—Two colonies of a freshwater 'Entoproctan' from Annamalainagar.

There is a distinct constriction between the calyx and the stalk, and the calyx is deciduous. In the specimens under observation in the laboratory, I find that the calyces are often shed and 'new heads' are grown on 'old shoulders'. Old stout stalks surmounted with very small buds are frequently met with. The calyx has no aboral shield like that in *Loxosomatoides*.[3] The lophophore is slanting and the number of tentacles is only nine, whereas in *Urnatella*[2] it is twelve to sixteen. The sphincter of the calyx is very prominent.

The general organisation of the polypide as seen in optical section is represented in Fig. 2. When the tentacles are unfolded the lophophore may be seen to surround a relatively prominent vestibule. As in the case of *Loxosomatoides*[3] there is no epistome. The alimentary canal has the usual shape found in Entoprocta. In living specimens the movement of the green contents of the stomach, due to ciliary action, is well seen. The large rectum in the extended condition and its opening into the vestibule are represented in Fig. 2. The ganglion and the gonad are made out in stained preparations, while the excretory organ is distinct in sections. In all the specimens examined by me the gonad was immature and reproduction was entirely by budding. No trace of a brood pouch has been made out so far in any of the specimens.

In the family Urnatellidæ, as described by Annandale,[4,5] *Urnatella* is the only genus which has a segmented stalk, with each segment heavily 'chitinised' and capable of functioning as a resting bud. The Entoproctan from Annamalainagar shows these features, but differs from *Urnatella* in the number of tentacles and segments of the stalk, and also to some extent in the shape of the segments, branching of the stalks and their mode of origin from the substratum.

Further work is in progress and a complete account of this South Indian Entoproctan will be published in due course.

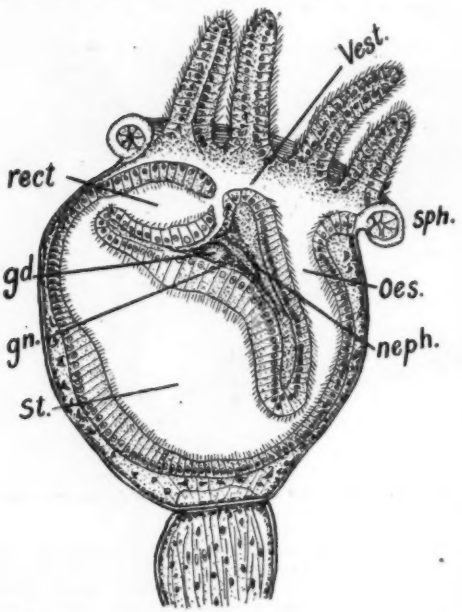

FIG. 2.—A polypide as seen in optical section, *gd.*, gonad ; *gn.*, ganglion ; *neph.*, excretory organ ; *œs.*, œsophagus ; *rect.*, rectum ; *sph.*, shincter; *st.*, stomach; *vest*, vestibule.

My best thanks are due to Dr. H. Srinivasa Rao for sending me an account[6] of *Urnatella*, and to Dr. Baini Prashad for the loan of some of the references from the library of the Zoological Survey of India.

Annamalainagar, R. V. SESHAIYA.
S. India,
May 15, 1944.

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AN INTERESTING CASE OF DIAPAUSE IN THE CATERPILLARS OF THE CARDAMOM ROOT-BORER, *HILAROGRAPHA CAMINODES* MEYR.

IN the course of a preliminary investigation on the insect pests of cardamom in Travancore I found that a large number of full-grown caterpillars of the cardamom root-borer, *Hilarographa caminodes*, remain without feeding in a practically inactive state, for an unusually long period during the summer months till the advent of rains. This resting condition was observed only among those caterpillars that worked their way along the root into the base of the rhizome whereas those that attained full growth in the root itself pupated without delay. The phenomenon was noticed from February to April-May.

The occurrence of diapause is well known among insects and there is considerable literature on this interesting phenomenon and different workers have given various theories on its causation and the part played by the different factors associated with it. A recent work on the subject is by Prebble[1] who gives a complete review of the literature on the subject while giving a detailed account on the diapause and the related phenomena in the European spruce sawfly *Gilpinia polytoma*. In the words of Prebble (*op. cit.*), "the coincidence of resumption of development with moisture changes in the natural environment and the simulating effect of water addition either during the normal diapause period or at the time of its normal cessation clearly indicate the important role of water in most insect species". As Squire[2] says, all remote causes of diapause boil down in physiological terms to an unfavourable free-water balance. Recently I have recorded the occurrence of diapause in the developing eggs of certain Indian fishes where also water plays an important part.[3] Andrewartha[4] has shown that even the facultative diapause found in *Austroicetes cruciana* could be eliminated by subjecting it to certain temperatures which help to convert the modified yolk into a form suitable for the nourishment of the embryo and thus promoting katatrepsis. In this manner it is seen that both facultative diapause and obligate diapause are associated with nourishment. In India some work has been done on the diapause in the pink boll worm, *Platyedra gossypiella*, which has attracted attention in other parts of the world also where cotton is grown. In South India due to the absence of any extremes in climatic conditions the resting condition of the above insect is less pronounced than in the North and still less than in some other parts of the world.

It is difficult to say without further work the factor or factors responsible for diapause in the cardamom root-borer. Probably it is a case of facultative diapause as in *Platyedra gossypiella* where nutrition of the larvæ is responsible for the phenomenon. Factors responsible for diapause in the root-borer might have been indirectly induced by dry conditions since such a resting condition is not seen during the wet season. During the hot dry months some change might be brought about in the tissue of the plant thereby affecting the nutrition of the insect. How exactly this takes place cannot be said without a study of the chemical contents of the rhizome during the different parts of the year.

Central Research Institute,
University of Travancore,
Trivandrum, S. JONES.
May 23, 1944.

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REVIEWS

Soviet Russia. By K. S. Hirlekar. (Popular Book Depot, Bombay 7). Crown octavo. Pp. xxviii + 391. Paper cover Rs. 6-8-0; Cloth bound Rs. 7-8-0.

The publication *Soviet Russia* is a compilation of information in the shape of articles by different writers, selected and edited by K. S. Hirlekar. With a Foreword by the Rt.-Hon'ble Mr. M. R. Jayakar, the book describes the progress which modern Russia has made in many periods of human activity, within a period of fifteen years.

The book is free from politics and propaganda and contains factual information supported by statistical data, and consists of five parts, each part being divided into several chapters dealing with different topics.

The first part opens with a chapter describing U.S.S.R. in miniature and introduces the reader to glimpses of the economic, mineral and power resources and the national income of Russia.

Part II has several articles on Russia's industrial might and describes the phenomenal growth of heavy and light industries, and development of communications on land, water and air.

The third part is devoted to factual statements on the phenomenal and spectacular developments in agricultural production and to the formation and functioning of State and collective farms.

In Part IV is summed up the different directions of material advance and the resulting cultural development on the mass scale.

The circumstances created by the war and the consequent effects on Russian national economy and life are described in Part V.

A perusal of the book shows how sustained effort and application of science to national reconstruction have enabled Russia to advance agriculturally, industrially and culturally within the brief space of fifteen years, and to occupy the foremost place among the nations of the world.

Abolition of illiteracy, mass technical education, establishment of numerous institutions for higher learning and scientific research, establishment of electric power stations, expansion and development of agriculture initiated and worked by the Government have produced such quick results in the economic and cultural development of the country and its people who are guaranteed education and work and wage when sound in body and health, and maintenance in old age and sickness.

In these days when there is country-wide awakening and desire for economic reconstruction the book provides stimulating reading.

B. V. N.

Systematics and the Origin of Species. By Ernst Mayr. (Columbia University Press, New York), 1942. Pp. xiv + 334. Cost $4.

This thirteenth volume in the Columbia Biological series promises to be an outstanding book and a signal contribution to the science of animal systematics. Of the many subbranches of Zoological science, taxonomy has produced the most prolific results, but somehow has been the least respectable. This appears at once strange and sad since the essence of a clear understanding of biological phenomena is correct systematics. This has been clear from the days of Darwin who put systematics on the map and who showed the unmistakable relationship between systematics and interpretational biology. But Darwin drew no distinct line between species and infraspecific divisions and this is one of the most outstanding ways in which modern systematics differs from the old. The recognition of the importance of variations and infraspecific differences is becoming more and more common and it will probably be found in other groups of animals as it has certainly been found in birds that these differences, which, till now, used to be called minor and purposeless, have a profound bearing on the problem of the evolution of organisms. With the recognition of the importance and significance of these minor variations has developed a close affinity between the systematist and the geneticist particularly, and their combined labours have given birth to the New Systematics, a refreshingly modern version of the Old. The Darwinian faculty of interpreting simple biological facts like adaptation, variation, migration, etc., into the larger concepts of biological phenomena, drawing from them mighty conclusions on the origin of species is still there as the basis of the New Systematics as of the Old, but what the former has done is to emphasise the undoubted importance of the smaller variations in this grand process of species formation.

Dr. Mayr is particularly well suited for his task as the exponent of Modern systematics for he is himself an outstanding Ornithologist. The taxonomy of birds is the best known and it is possible that less than 2 per cent. of the number of species of birds is still unknown, and he has had unique opportunities of studying every facet of life of this fascinating group of animals, and always with a sympathy and understanding and a breadth of vision which many old systematists lacked and which has helped in his interpretation of the varied phenomena of the life of these animals. It is just this breadth of vision, just this understanding and sympathy that has enabled him to organize and marshall his observations into a coherent account of the evolutionary phenomena of animals. But it is not as if Dr. Mayr has filled his book with his own "pre-occupation". Rather, much valuable information on other groups of animals, much of what is known of the distribution and systematics and ecology of mammals, Amphibia, and insects is incorporated in what promises to be a treatise on the systematics of animals. Here is a book that ranks with Darwin's *Origin of Species* in importance, treatment and originality of conception and thought, for that is the only book we can think of as its equal. Any who reads

it will discover the similarity, will be struck by the same stupendous array of facts assembled in it. In fact, Dr. Mayr's book goes much farther and goes much deeper, and to that extent it is an extension of the study. There is no doubt that Dr. Mayr has put animal systematics on a higher and more respectable plane than it has ever been since the days of Darwin. B. R. S.

Sulfonamides. By C. M. MacLeod, P. H. Bell, H. I. Kohn, J. S. Lockwood, R. O. Roblin, Jr., J. A. Shannon and H. B. van Dyke. *Annales of the New York Academy of Sciences*, Vol. XLIV, Art. 5, pp. 445-538. (Published by the Academy, New York), Dec. 14, 1943.

The spectacular results obtained with prontosil and sulfanilamide in the treatment of the streptococcal infections started a tremendous trace all over the world to discover more active derivatives and to chart out the spectra of their therapeutic activity. So much were the results beyond expectation that immediately after a drug was found to be effective in the experimental infection, it was rushed for clinical trials even before its pharmacology was thoroughly studied. Only the outstanding results so far obtained justify this unorthodox method and impatience. Now that this race has slowed down (which is due to the paucity of additional ring systems to suit the synthesis of more sulfanilamide derivatives by the chemist) the researchers are settling down in calmness to shape the sulfonamide therapy from an emperical hit-or-miss project into a science with a rational basis. Very significant results have obtained in this direction and as pointed by Dr. MacLeod in his Introduction, "the sulfonamide drugs have been the cause of a radical change in the approach to chemotherapy, not only as it has affected their own use but that of unrelated compounds also". The papers presented in the volume under review, which is the result of a conference on Sulfonamides held by the Sections of Physics and Chemistry of the New York Academy of Sciences on April 16 and 17, 1943, are concerned with these important phases of the problem.

The volume begins with a short introduction by MacLeod. Next, Roblin and Bell present their paper on "The relation of structure and activity of sulfanilamide type of compounds" (pp. 449-54), which is a sequel to their well-known contribution on the same subject (*J. Amer. Chem. Soc.*, 1942, 64, 2905). This theory postulates that in the sulfonamide compounds, the more negative the SO_2 group, the more bacteriostatic the compound will be. The acid dissociation constants of the sulfonamides are shown to furnish an indirect measure of the negative character of the SO_2 group and an attempt is made to link the dissociation constants of the N^1-substituted sulfanilamides with their activity.

The next paper by Shannon on "The relationship between chemical structure and physiological disposition of a series of substances allied to sulfanilamide" (pp. 455-76) is of great importance. Since the sulphanilamides are being very extensively used against a variety of diseases ranging from the localised infection to severe septicemia, it is imperative to know whether the compounds used reach the specific sites in effective concentrations and are also maintained therein for sufficiently long. A knowledge of the absorption, distribution and excretion of the drugs is thus of great importance in the choice of the right drug for the treatment of a specific infection. Shannon presents very valuable data on the distribution and excretion of some thirty derivatives of sulfanilamide and closely allied compounds which are representative of typical groups and thus the data obtained regarding the changes in the absorption and distribution with the changes in molecular structure are very interesting. It is indicated that at least two factors, *viz.*, the strength of the acidic grouping and the molecular structure of the compound as a whole, are concerned with the distribution and excretion of the sulfonamides. The hope is given that "it may ultimately be possible to limit both the theatre of operation of an active substance within a series as well as the duration of the effect produced through the proper modification of the molecular structure". It is just a reasoning on these lines that has led to the evolution of sulfaguanidine and succinylsulfathiazole as intestinal antiseptics, though this represents only the first step.

In the next article on "The toxic effects of the sulfonamides" (pp. 477-502), van Dyke gives a very useful review of eighty papers on the subject which will be of great benefit to the clinicians.

"Antagonists (excluding p-aminobenzoic acid), dynamists and synergists of the sulfonamides" (pp. 503-24) form the subject-matter of the paper of Kohn. After an introduction which stresses the importance of the study, there is a section 'on the determination of activity' in which the method to be adopted in practice to estimate the potency of the sulfanilamides is discussed. The next section gives a very important survey of 56 papers published on the subject covering various antagonists, synergists and dynamists of the sulfonamides. The last section 'on the mode of action' contains a discussion of the mechanism of action of the sulphonamides. There is an account of the theory of Harris and Kohn of primary and secondary antagonists in which para-aminobenzoic acid is considered to be the primary antagonist while methionine, xanthine, glycine, serine, etc., the secondary antagonists.

The volume concludes with the article of Lockwood on "The action of sulfonamides in the body" (pp. 525-38) which, as the author says, 'attempts to cross the chasm that always separates the test tube from the tissues'. The subject-matter is discussed from three points of view, *viz.*, the clinical experience, the reactions of sulfonamides on bacteria growing in natural fluids of the body and those scenes of encounter between the bacteria and the host in which the sulfonamide is used as the weapon of the host. Not infrequently the author's enthusiasm bursts into poetic eloquence and the reviewer could not overcome the temptation to cite as an example his picture of one of the important limitations to the sulfonamide therapy: "If an invasive infection could be likened to a forest fire sulfonamide therapy serves as a damping rain, which suffices to check the alarming wind-

blown spread of the fire in the underbrush but does not extinguish the burning of the trees that the fire had already overwhelmed. Within a season or two the underbrush is restored, but the scarred trees remain as semi-permanent reminders of the conflagration ..... just as a rainstorm will not put out a smoldering fire in a peat-pog, so will sulfonamide therapy fail by itself to cure most of the deeply entrenched chronic infections ....." There is a discussion on the role of para-aminobenzoic acid and the article concludes with pointing out the possible avenues of investigation in future.

In short, this volume will amply repay the careful study it deserves; while the specialist in the field has a chance to check up his notes and appreciate other points of view, others interested have got a golden opportunity to get acquainted with some important phases of the subject without having to ponder through the ever-growing voluminous literature scattered in all the journals known. K. GANAPATHI.

The Purification of Water Supplies. By George Bransby Williams. (Chapman & Hall Ltd., London), 1944. Pp. ix + 83 + 4. Price 7/6 net.

This small booklet of about 90 pages is written by a Water Engineer who probably served in India, for the use of Engineers and others dealing with problems of water treatment. The title "The Purification of Water Supplies" leads one to expect an exhaustive presentation of the various aspects of modern water works practice; but the author confesses that exigencies of war, shortage of paper and other incidental difficulties have made him restrict its scope and size. This has naturally resulted in his having to condense both in matter and illustrations which has adversely affected its usefulness to a larger circle of scientists and others who are interested in water supply problems.

The author has collected information on the current methods of water supply engineering from various sources and the chapters on alum coagulation, flocculation and sedimentation give in a concise form the basic principles involved in these processes together with the recent advances in equipment and design evolved in the States and published in American literature. The chapter on sterilization and removal of tastes and odours is fairly exhaustive and incorporates the recent ideas on breakpoint chlorination; sterilization by ozone, algal control, etc.

The chemical side of the subject might have been better presented. The Engineer-author who is probably not well equipped for this task attempts to cover in about 12 pages such theoretical subjects as Valency, Electronic state of matter, Colloids, Periodic classification, etc. The major portion of the matter presented in this chapter might have been omitted with advantage and the space thus saved devoted to a study of the various sources of water and the special problems of purification connected with them. It would have been better if the author had obtained the help of a competent chemist to go through the chapter on the 'Chemistry of Water Treatment' and other portions pertaining to dechlorination and water softening. This would have helped to obviate gross errors such as (1) the mention of *sod. bisulphide* for the removal of chlorine, (2) pH below 4·4 is neutral acidity and (3) sulphur is acid to phenolphthalein. The author writes, "When Mendelyiff made his classification, there were numerous gaps in the list, and he predicted the existence of unknown elements to fill the gaps. Actually some of these elements have since been discovered. Even a tyzo in chemistry knows that not only all the missing elements mentioned by the Mendelyiff have been discovered but as a result of the classical work of Mosley, Aston, Rutherford, and others. Most if not all elements whose existence is possible have been discovered.

A reference is made to the Madras City Water Supply and the difficulty in evolving a satisfactory method of purifying it by Slow Sand Filtration to render it acceptable from the æsthetic point of view. The author's suggestion that a successful solution of the problem would be found in the American practice of superchlorination followed by dechlorination is rather amateurish, considering the vast amount of work already done on this subject by the Madras Committee on Water and Sewage Purification. The Red Hills Lake water is admirably suited for mechanical filtration but the dose of coagulant required, especially in the summer months when the lake level is low and the colloidal organic content of the water high, is uneconomical.

Some important subjects like Æration, Fluorine and its removal from water, Hexametaphosphate treatment of water for corrosion control, recent improvements in the washing of mechanical filters by a system of surface wash, are not mentioned or given the importance they deserve.

The author's description of the condition of the water supply in villages in India is only partially true; many great improvements have taken place in rural water supplies as a result of the enlightened policy followed by the provincial Governments which allotted large sums of money for the improvement of village water supplies during recent years. The author quotes extensively. He should have placed the quotation under commas. One does not know where the quotation begins and ends.

The book as is to be expected from a firm of well-known publishers, is well bound and printed; but the price of 7/6 for a small book of the size and scope seems to be excessive, even in these abnormal days of war and paper shortage. The book, however, gives in a concise form information regarding recent progress in the Science of Water Purification and may well serve as a good guide to Engineers and others engaged in the investigation and design of water treatment plants.

P. V. S.
K. V. S.

The Drainage Pattern of Mysore State. By C. S. Pichamuthu, Professor of Geology, University of Mysore. (*Journal of the Mysore University*), Vol. IV, Part XI, pp. 171-87.

Every geographer in India has to be grateful to Professor Pichamuthu for the lead he has

been giving to others in the elucidation of the geomorphology of Peninsular India. The need for such type of work was being felt since a very long time.

The drainage pattern of Mysore is a little peculiar when compared with the general trend of drainage in Peninsular India. Professor Pichamuthu traces a relationship between the alignment of rock formations and the river systems of Mysore. The schists composed of the ferruginous quartzites and quartzites are found to be more resistant thus influencing the trend of the tributaries of the peninsular rivers as compared with the gneisses of the region. The universal law of differential weathering has been clearly indicated. The different type of topography exhibited by quartzites and gneisses of Mysore is similar to the one seen in the Nagari area.

The rivers of Mysore generally have a N.-W. and S.-E. trend in the west, N.-N.-W. and S.-S.-E. trend in the middle and northerly and southerly trend in the eastern position of the State. The only exceptions are the Tunga, Bhadra, Vedavati and Cauvery. Of these Vedavati has a number of gorges cutting across the resistant schists, but flows northwards when it meets the Closepet granite. Cauvery, since it flows in a gneissic country, has a general easterly trend.

The above type of arrangement is explained by Professor Pichamuthu as due to a dome with a central axial line of elevation running in an E.-W. direction across the State. The subsequent deviations in the trend of rivers are assigned to the subsequent elevation of the Western Ghats.

The remarkable east-west divide does not seem to have a structural basis. This may be either a superimposed feature or it may be due to dislocation in the northern and southern portions of the State. More evidences are required to indicate the uplift of the Western Ghats subsequent to the alignment of the drainage pattern. The rivers at the west, on the plateux and on the plains of the coast belong to different cycles of erosion and the pattern has to be studied from the source to the mouth. In this connection Cushing's[1] paper and the papers on the Palar[2] basin will give us some insight. Cushing considers most of the regions indicated in this paper as portions of an elevated peneplain.

Professor Pichamuthu is giving an impetus to Indian physiographers by the work that he has been doing and we look forward to an elaboration of many of the suggestions made in his paper.

B. VARADARAJA IYENGAR.

1. "The East Coast of India" S. W. Cushing, *Bulletin of American Geographical Society*, 1913. 2. *Journal of the Madras Geographical Society*.

MINERAL NUTRITION OF PLANTS*

RECENT advances in our knowledge of plant nutrition have undoubtedly formed one of the important scientific foundations of modern crop production. Plant tissues are dominantly organic in nature once the water is driven off. Hence, the real problem of plant nutrition, from the point of view of the plant, is not, strictly speaking, a problem of inorganic nutrition but one of organic nutrition. What we should like to learn about the inorganic nutrients is how, directly or indirectly, they enter into the synthesis and utilization of organic compounds. Thus far, our knowledge of the functions of inorganic nutrients, except as they are present as components of the structure of indispensable organic compounds, has been very scanty. More recently, however, the application of the principles and techniques of biochemistry to plant nutrition has yielded a corpus of integrated knowledge on the mineral intake and metabolism of plants. A good deal of this knowledge has come from Dr. Hoagland's flourishing school of research at California, represented by numerous publications during the last quarter century. Workers in this field of research will, therefore, keenly welcome the publication of these lectures, seven in number, which, given originally at the Harvard University under the Prather Lectureship, present a general perspective of several important aspects of plant nutrition. The book is illustrated with many tables, text-figures and photographs of excellent quality and a selected bibiliography is appended to each lecture. Most of the illustrative material is drawn from the experiences of the Californian group of workers. It is but natural that, in lectures of the present type and objective, the author should have emphasized on the work with which he has had the most direct contact.

The first lecture introduces the reader to a brief survey of the soil-plant-air system with its innumerable interrelations and interreactions. The early theory of Liebig that the fertility of the soil does not rise and fall in exact proportion to the mineral elements withdrawn from or added to it has given place to the present-day dynamic interpretation of the soil as an ever-changing system, biologically controlled by the activities of the micro-organisms and of the higher plants growing in the soil. On this assumption, the concept of "supplying power" of the soil and the interrelation of the solid to the liquid phase of the soil become considerations of paramount significance in understanding the nutrient capacity of the soil.

The second lecture is devoted to a resumé of the development of knowledge of certain chemical elements needed by plants in minute amounts. The author has appropriately used the term "micro-nutrient" to cover these elements, hitherto called by students of plant nutrition variously as "rare", "minor", or "trace" elements. The functions of these elements, effective in minute amounts in plant-growth and metabolism, are, however, still in a large measure obscure, although there is little

* *Lectures on the Inorganic Nutrition of Plants*, by D. R. Hoagland (The Chronica Botanica Co., Waltham, Mass.; Macmillan & Co., Ltd., Calcutta), 1944, pp. 226, Price $ 4·00.

doubt that they act in some not altogether well understood way as biochemical catalysts. Thus, zinc, deficiency of which results in a marked effect in retarding protein and, to a less extent, starch synthesis, may be a component of a catalytic system necessary for the phosphorylation of glucose (known to be a step in starch synthesis) or possibly of an amino acid. Likewise, boron requirement may arise on account of its role in the formation of pectic compounds: these contain galactose derivatives which require an inversion of H and OH on one of the C atoms if they are formed from glucose, this inversion being possibly brought about by boron. Several phases of organic metabolism need exploration before the exact mode of action of the different "micro-nutrient" elements is elucidated.

Another aspect of the problem of "micro-nutrient" deficiencies concerns their relation to animal nutrition. The requirements of the plant and of the animal are not necessarily coincidental quantitatively and not always qualitatively. Our knowledge of the factors that govern the quality of plant products from the point of view of human and animal nutrition is greatly limited but doubtless we should expect many unifying principles of metabolism common to living organisms of different categories. The "micro-nutrient" elements present an interesting aspect of these convergent investigations.

The mode of entry into the roots of the essential chemical elements and their upward movement and distribution in the plant are dealt with in the next two lectures. Radio-active isotopes or tagged ions have been of great value as a tool in these investigations inasmuch as they can indicate their presence in most cases without any operation on the plant, by application of a Geiger-Müller Counter and by radio autographs to the undisturbed tissue. It is now known that the intake of the nutrient ions is not, as many text-books have taught us, merely a diffusion process proceeding to attainment of equal concentrations or activities of a solute in internal and external phases, and that ion intake often takes place against gradient concentrations, this capacity being of course dependent on metabolic activities of the cell by which cellular energy is made available for ion transport.

A large portion of the nutrient salts absorbed is translocated to the upper part of the plant, there to serve the functions of growth and metabolism in the various above-ground organs. At one time, this upward movement of salt was, at least by implication, regarded by many botanists as a simple matter, transpiration being frequently assumed to play a determinative role therein. Recent evidence, much of it adduced by the author and his collaborators, would suggest that the absorption of salt and the absorption and transpiration of water are independent processes and that salt does not move in a plant merely in relation to the water absorbed. Essentially, salt absorption and movement are determined by the metabolic activities of the plant which are dependent upon the availability of energy-containing compounds or special organic units, and of substances catalysing or regulating metabolism, for all of which photosynthesis is ultimately necessary. Our knowledge of salt movement in the plant is still inadequate although the data reported permit a much closer approximation to an understanding of these phenomena than has been available in the past. One especially interesting aspect for study with regard to solute movement in plants will relate to the so-called "flow-back" of nutrients from the plant to the soil for which satisfactory experimental evidence is apparently lacking, although it is known that something like a circulatory movement of mobile inorganic nutrients can take place in the plant by which solutes are carried in the wood to foliar regions from which they may be re-exported through living cells even back to the roots.

The fifth lecture discusses some of the physiological aspects of the inorganic nutrition of plants as they are offered for examination under the controlled conditions of artificial culture technique (water culture, "hydroponics", sand culture, and gravel culture). These have certainly been of great service as tools for research in plant nutrition and, in recent years, have attracted an extraordinary amount of attention as a means not merely to study general scientific principles of plant nutrition but also to produce crops commercially. Many, among the uninformed, seem to gain the impression that a revolutionary development has taken place and that soon we could dispense with soil as medium for crop-growth on large scale. It should be distinctly borne in mind, however, that, save in unusual situations, artificial culture methods are at present applicable in a commercial way only to expensive green house crops. Even there, practical and economic factors should receive critical consideration before their adoption can be justified.

The chemical processes occurring in plant tissues as salt is moving into or through the cells, or soon after the salt has been accumulated are not well understood and the author discusses in his sixth lecture several aspects of the problem with special reference to the nitrogen and organic acid metabolism of higher plants. Progress in understanding the metabolism of plant-cells in relation to salt accumulation will depend largely on advancing knowledge of the biochemistry of respiration, together with a correlation of biochemical transformations with the maintenance of organized structures in the protoplasm.

The concluding chapter presents an illuminating discussion of the potassium nutrition of plants both in relation to soil problems and the functions of potassium in plant metabolism. These studies serve well to illustrate the ramifications of research in an attack on any general problem of plant nutrition and the need of many approaches to proceed towards a goal of increased understanding of soil-plant interrelations.

As the author has pointed out in his prefatory note, these lectures do not have the characteristics of a monograph or a text-book but it is not the least of the merits of Professor Hoagland's exposition that they are both authoritative and inspiring.

A. SREENIVASAN.

SCIENCE NOTES AND NEWS

Chinese scientists are taking their full share in their country's war effort. Cut off from contacts with scientific research in the rest of the world they work under conditions of the utmost difficulty and hardship, yet produce remarkable results. The physics section of the Peiping Academy, which made the long journey from occupied territory to Free China after the Japanese invasion, has turned over almost wholly to war production. A plant for grinding lenses for microscopes and telescopes has been set up, and the Academy is actually producing microscopes for teaching and research, having worked out all its own necessary apparatus. All the optical glass for this plan is supplied by Britain. The Chinese have developed entirely new methods for making quartz piezo-electric crystals for frequency stabilisation in radio work. These are being produced in regular quantity so that a supply may be available at need for the other United Nations. Dr. Tsien Ling-Chao, Director of the Physics Section, has based some of his methods on the optical work of a Chinese philosopher, Mo-Tze, who lived 400 B.C.

An atmospheric research committee has recently been constituted under the ægis of the Council of Scientific and Industrial Research to investigate problems connected with the upper air. Dr. M. N. Saha of the Calcutta University is the Chairman of the Committee and its members include Dr. C. W. B. Normand, Prof. H. J. Bhabha, Dr. D. S. Kothari, Dr. S. K. Banerjee, Dr. S. M. Isaque, Prof. S. Bhagavantam and Dr. K. R. Ramanathan.

Dr. Mortimer Wheeler, Director-General of Archæology, Government of India, has suggested the formation of a National Museum in a central place in India which would provide a complete conspectus of Indian civilisation during the past five thousand years or more, an institution which would be the Indian counterpart of the British Museum.

The Indian Lac Cess Committee at its recent meeting has decided to appoint a lac information officer for India for the purpose of unifying the publicity, propaganda and administration work of the Indian Lac Research Institute and for establishing trade contacts within the country.

Experiments carried out at the Forest Research Institute, Dehra Dun, indicate that tar acids of Indian origin are suitable for the preparation of resin adhesives. These are important in the manufacture of high grade plywood whether for marinecraft or aircraft or for any other purpose where high grade strength complete freedom from attack by fungi and water-proof qualities are of importance. Imported resin adhesives being short of supply, the work done on resin adhesives of indigenous origin in the Wood Preservation section of the Institute has been published.

The Government of Madras have directed that a Provincial Post-War Reconstruction Committee be constituted with the Adviser in charge of the Development Departments as Chairman and the Secretary to Government, Development Department, and the Director of Industries and Commerce, Joint-Director of Industries and Commerce, the Director of Agriculture and the Officer in charge of the Geological Party in Madras, and the Chairman, National Service Labour Tribunal, Madras, as members. The Special Development Officer will be the Secretary of the Committee. The Committee will be entrusted with the task of preparing plans for he reconstruction based on knowledge and information now available and capable of being executed within the measurable time of five to ten years immediately after the war.

An Advisory Mission of Machine Tool Utilisation Experts from United Kingdom, headed by Sir William Stainer, F.R.S., a former Chief Mechanical Engineer of the London, Midland, and Scottish Railway Company, and Scientific Adviser, British Ministry of Production, is shortly visiting India to advise the Central Government on the measures to be taken to ensure that the fullest use is made of the available engineering plant and machine tools in India. Other members of the Mission are: Mr. A. N. Jervis, from British Railways Staff; Mr. W. H. G. Clifton, Production Engineer, Ministry of Aircraft Production; Mr. B. W. Palmer, Manager of Railway Department of Messrs. G. D. Peters, Nr. Slough; and Mr. I. V. Woolley, Machine Tool Control, British Ministry of Supply.

The University of Texas, U.S.A., announces the discovery of two new vitamins which may possess properies helpful in the control of anæmia and nervous disorders.

Thirteen students, including a lady, from nine universities all over India have been awarded scholarships from the J. N. Tata Endowment for higher education abroad. Eight of them are proceeding to the United States, four to Britain, and one to Canada. The recepients of the scholarships are:—Mr. A. K. Dutt (Dacca), Mr. N. Sreenivasan (Madras), Mr. H. K. Joshi (Benares), Mr. B. D. Tilak (Bombay), Dr. D. N. Solanki (Benares), Mr. S. S. Cardmaster (Bombay), Mr. Rajendra Singh (Calcutta), Mr. K. Subramaniam (Madras), Mr. Raiz Ahmad (Aligarh), Mr. Lalit Prasad (Patna), Mr. N. K. Ananthanarayana Aiyar (Mysore), Mrs. K. Sunanda Bai (Indian Institute of Science) and Mr. Amol Rattan (Punjab).

Dr. Sadgopal, Chief Chemist, Messrs. The Hindustan Aromatics Co., Naini, Allahabad, who has been invited by the Chief Editor, *Dictionary of Economic Products and Industrial Resources of India*, to contribute an article on "Perfumery Industry in India", writes to us as follows:—"The proposed contribution by me shall have to include information on the following points: (i) History of the industry, (ii) Raw materials—place or places of availability, quantity and quality, (iii) Capital, labour, number and location of factories, with their addresses, (iv) Manufacturing processes employed, (v) Variety and quality of products manufactured, (vi) Markets at home and abroad, (vii) Future developments, (viii) Value of total local production, imports and exports for the last ten years, (ix) Any research work carried or in progress. I have the honour to invite you, therefore, to be good enough to send me all information in your possession on the lines suggested above. Due acknowledgments shall gladly be made wherever necessary and permitted by the sources of information. I shall deem it a favour if you will be so good as to make a due acknowledgment of this letter and send me the necessary data *before the middle of August* 1944.

The Government of India have sanctioned a scheme of scholarships for students belonging to the scheduled castes who wish to pursue their studies in scientific and technological subjects beyond the Matriculation stage. The total amount awarded every year will be Rs. 3,00,000.

The scheme which aims at improving the educational and economic conditions of scheduled castes will have immediate effect. The number of scholarships to be awarded and their amount has not yet been fixed, but the amount awarded will cover the entire cost of education including fees, cost of books and in the case of residential scholars their maintenance charges. Some of these scholarships will be given for studies in India and some in foreign countries.

For courses commencing in 1944 applications are being called through Directors of Public Instruction, Superintendents of Education and Vice-Chancellors of Universities. All the scholarships in 1944-45 will be for studies in India. Arrangements for students to proceed abroad are expected to be made next year.

SEISMOLOGICAL NOTES

(January-June)

Among the earthquake shocks recorded by the seismographs in the Colaba Observatory during the period January-June 1944, there were three of great, five of moderate and four of slight intensities. The details for those shocks are given in the following table:—

Date	Intensity of shock	Time of origin I.S.T.	Epicentral distance from Bombay	Co-ordinates of epicentre	Depth of focus	Remarks
		H. M.	(Miles)		(Miles)	
Jan. 6	Moderate	03 43	2390	Lat. 3°·5 S., Long. 99°·5 E. near Sumatra.		
16	Moderate	06 20	9850			Felt in Argentine. Serious damage in San Juan.
Feb. 1	Great	09 52	3115	Lat. 41°·8 N., Long. 25°·8 E.		Felt in Turkey. Great destruction in Gerede.
29	Great	22 58	1390			Epicentral region near the Maldive Islands. Tremors felt in Ceylon and Madura.
Mar. 10	Moderate	04 33	1940			
15	Slight	11 34	1490	Lat. 41° N., Long. 75° E. near Samarkahand.		
22	Slight	07 13	3960	Lat. 4° S., Long. 127° E. in Banda Sea.	125	
Apr. 10	Slight	10 03	1000			
26	Moderate	08 24	4415	Lat. 2°·4 S., Long. 135° E. in Geelvink Bay, Dutch New Guinea.	62	
27	Great	21 08	4290	Lat. 7° S., Long. 131° E.		
May 25	Moderate	19 28	5100		62	
30	Slight	16 25	1520			

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